# RAPTOR RESEARCH


| | |
|---|---|
| Volume | 13 |
| Number | 4 |
| Winter | 1979 |

Raptor Research Foundation, Inc.
Provo, Utah, U.S.A.

RAPTOR RESEARCH Winter 1979
Volume 13 Number 4, Pages 97–128

## CONTENTS

*SCIENTIFIC PAPERS*

Distances Between Birthplace and Breeding Place in Sparrowhawks and Other European Raptors—I. Newton ..... 97
Decomposition of Raptor Pellets—James R. Philips and Daniel L. Dindal ..... 102
Observations on the Behavior of Wintering Bald Eagles—Howard I. Russock ..... 112
Use of Hunting Methods by Ferruginous Hawks in Relation to Vegetation Density—James S. Wakeley ..... 116
Coopers Hawk Attacks Sharp-tailed Grouse—D. L. J. Moyles ..... 120
Subterranean Nesting by Prairie Falcons—Bruce A. Haak and S. Jon Denton ..... 121
Red-tailed Hawk Preys on Adult Sage Grouse in Northern Utah—Cal McCluskey ..... 123

*ANNOUNCEMENTS* ..... 124

*ABSTRACTS* ..... 125

*BOOK REVIEWS* ..... 126

**RAPTOR RESEARCH**

Published Quarterly by the Raptor Research Foundation, Inc.



The Raptor Research Foundation, Inc., welcomes original articles and short notes concerning both diurnal and nocturnal birds of prey. Send all papers and notes for publication and all books for review to the Editor. Most longer articles (20 or more typeset pages) will be considered for publication in *Raptor Research Reports,* a special series for lengthy and significant contributions containing new knowledge about birds or new interpretations of existing knowledge (e.g., review articles). However, authors who pay page costs (currently $20.00 per page) will expedite publication of their papers, including lengthy articles, by ensuring their inclusion in the earliest possible issue of *Raptor Research.* Such papers will be in addition to the usual, planned size of *Raptor Research* whenever feasible.

SUGGESTIONS TO CONTRIBUTORS: Submit all manuscripts in duplicate, typewritten, double spaced (all parts), on one side of 8½ × 11 inch paper, with at least 1 inch margins all around. Drawings should be done in India ink and lettered by lettering guide or the equivalent, if possible. Photographs should be on glossy paper. Avoid footnotes. Provide an abstract for all papers more than four double-spaced typed pages in length, not to exceed 5 percent of the total length of the paper. Keep tables at a minimum, and do not duplicate material in either the text or graphs. For advice concerning format refer to the Council of Biological Editors' Style Manual for Biological Journals or to previous issues of *Raptor Research.* Proofs will be sent to senior authors only. Major changes in proofs will be charged to the authors. Reprints should be ordered when proofs are returned.

# DISTANCES BETWEEN BIRTHPLACE AND BREEDING PLACE IN SPARROWHAWKS AND OTHER EUROPEAN RAPTORS

**by**
**I. Newton**
**Institute of Terrestrial Ecology**
**Monks Wood Experimental Station**
**Abbots Ripton, Huntingdon PE17 2LS, England**

*Abstract*

Raptors that have been studied tended to settle and breed in the neighbourhood where they were born, and band recoveries (and hence dispersed birds) fell off exponentially in successive circles out from the birthplace. Within species, geographical or annual differences in dispersal distances occurred, probably dependent on the distribution of food sources and of vacant territories. Individuals in some irruptive populations tended to disperse further than those in other populations. In European Sparrowhawks and Hobbies, females dispersed further on average than did males.

*Introduction*

The question of how far raptors disperse from their birthplace to their subsequent breeding place is relevant both to population theory and to conservation. In this paper I shall summarize some information on this point from European banding schemes. For any such analysis, recoveries come mainly from members of the public, and the assumption usually has to be made that any bird of appropriate age reported in the breeding season was in fact nesting at the locality concerned.

I took care to separate the immatures, for ringing has already shown that these birds may summer in partly different areas from the breeding adults of their population. So far at least three such traits have emerged: (1) the immatures may remain all summer in "winter quarters," e.g., first-year Steppe Buzzard (*Buteo b. vulpinus*); (2) they may migrate north later and spend less time on the breeding areas than adults, e.g., Broad-winged Hawk (*B. platypterus*); or (3) they may migrate north but stop short of the breeding areas, e.g., second-year Osprey (*Pandion haliaetus*) (Olsson 1958, Osterlof 1951, Matray 1974, Schifferli 1965). Moreover, different populations of a species may behave in different ways, as may the different age-groups among the nonbreeders of a single population. In the Osprey, most recoveries of yearlings in summer come from the "winter quarters," most recoveries of second-year birds are from further north but not as far as the breeding areas, and only in later years are most recoveries from the breeding areas themselves. This pattern holds in both the Old World and the New (Osterlof 1951, 1977; Henny & van Velzen 1972). In the Black Kite (*Milvus migrans*), which migrates from Europe to Africa, a more protracted pattern is found, as the majority of summer recoveries come from progressively nearer the birthplace from the first to the fourth and later years (Shifferli 1967). In several migrant species, occasional adults are reported in summer on "winter quarters." In the literature it is usually assumed that these birds are skipping a breeding attempt rather than nesting far to the south of their usual range.

 Raptor Research 13(4):97–101

*Sparrowhawk*

It is convenient to start with the European Sparrowhawk (*Accipiter nisus*) because more records are available for this than for ay other raptor. The species is non-migratory in Britain, and, when the young become independent in August, they disperse outwards in various directions from the nest (Newton 1975). They begin breeding in their next summer or the one after, in their first or second year.

The breeding season recoveries of this species were mostly clustered around the birthplace and became sparser with increasing distance (fig. 1). Thus about 76% of 201 recoveries were within 20 km of the birthplace, and almost all were within 50 km. Treating all the recoveries together, their density fell off exponentially in concentric circles out from the birthplace, a drop of about 99% between the 0–5 km zone and the 21–25 km zone. This pattern was established by the first autumn and hardly changed thereafter, implying that in this species most birds dispersed within a few weeks of fledging to near where they would later breed. I therefore included all first-year birds in the analysis just described, even though some of them may not have nested.

*Other Species*

The breeding season recoveries of other raptors also thin out with increasing distance from the birthplace, but at different rates in different species. A circle drawn at 50 km round the birthplace would include 98% of breeding season recoveries of the British Sparrowhawk, 89% of the British Kestrel (*Falco tinnunculus*), 75% of the British Merlin (*Falco columbarius*), 71% of the Swedish Goshawk (*Accipiter gentilis*), 62% of the German Buzzard (*Buteo buteo*), and 43% of Fennoscandian Ospreys of breeding age (table 7). Using data from the European and Soviet ringing schemes, Galushin (1974) calculated the mean distance between birthplace and presumed breeding place for eleven raptor species. This distance was much greater in some of the irruptive species, which depended on sporadic food sources, than in the others.

**Table 1. Dispersal of Some European Raptors from Birthplace to Presumed Breeding Place.**

| Species (region, number) | % of all breeding season band recoveries within following distances (km) from birthplace | | | | | Reference |
|---|---|---|---|---|---|---|
| | 20 | 50 | 100 | 200 | 500 | |
| Osprey (Fennoscandia, 79) | ? | 43 | 59 | 67 | 77 | Osterlof 1977 |
| Black Kite (Switzerland, 11) | ? | ? | 91 | ? | 100 | Schifferli 1967 |
| Goshawk (Sweden, 55) | 31 | 71 | 84 | 93 | 98 | Hoglund 1964 |
| Sparrowhawk (Britain, 201) | 76 | 98 | 99 | 100 | 100 | B.T.O. records |
| Buzzard (Britain, 15) | 73 | 93 | 100 | 100 | 100 | B.T.O records |
| (Germany, 45) | ? | 62 | ? | 98 | 100 | Mead 1973 |
| (Denmark, 10) | 30 | 60 | 80 | 100 | 100 | Nielsen 1977 |
| (Fennoscandia, 15) | 67 | 95 | 100 | 100 | 100 | Olsson 1958 |
| Kestrel (Britain, 18) | 61 | 89 | 89 | 100 | 100 | Snow 1968 |
| (Holland, 150) | ? | 63 | 80 | 93 | 100 | Cavé 1968 |
| (Switzerland, 35) | ? | 43 | 46 | 51 | 91 | Schifferli 1965 |
| Merlin (Britain, 16) | 38 | 75 | 81 | 100 | 100 | Mead 1973** |
| Hobby (Germany, 12)* | 92 | 100 | 100 | 100 | 100 | Fiuczynski 1978 |

*Note:* *Probably all males, females disperse further; **amplified by letter.

The most extreme was the Rough-legged Buzzard (*Buteo lagopus*), with a mean dispersal distance of nearly 2,000 km (number of recoveries was not given).

Within species, geographical trends occurred, which accorded with regional differences in the stability of food sources. Mean distances between birthplace and breeding place were longer for the Kestrel (277 ± 57) and Common Buzzard (295 ± 105) in northern and eastern Europe than they were in western and central Europe (146 ± 59 and 60 ± 11 km), and longer still than they were in Britain (Galushin 1974, table 1). Among Goshawks in northern Europe, movements were longer in poor food years than in good ones (Haukioja & Haukioja 1970). Presumably birds had to search further, on average, in poor food conditions than in good ones until they found vacant areas with sufficient food.

*Sex Differences*

In two species, dispersal between birthplace and breeding place could be examined separately for the sexes, and in both species females moved farthest. In the Sparrowhawk this was evident from the British ring recoveries, in which two-thirds of males had moved less than 10 km from their birthplace, and two-thirds of females had moved more than 10 km (table 2). In the Hobby (*Falco subbuteo*), it was evident from a local study near Berlin, in which 85% of 180 male Hobbies seen breeding had been raised in the area, compared with only 11% of 174 females ($P<0.001$). As the

**Table 2. Sex Difference in the Dispersal Distances of British Sparrowhawks between Birthplace and Presumed Place of First Breeding.**

| | Dispersal distance | |
|---|---|---|
| | Less than 10 km | More than 10 km |
| Males | 20 | 11 |
| Females | 9 | 20 |

Significance of difference, $x^2 = 6.7$, $P<0.01$

Figure 1. Breeding season recoveries of ringed Sparrowhawks showing distance of recovery from birthplace, which is represented by the center of the circle at the cross lines.

sex ratio among nestlings ringed in the area was about equal, this difference implied a much greater fidelity to birthplace among males than among females (it was too great to be due to differential mortality) (Fiuczynski 1978). Such sex differences in dispersal may occur because males and females are exposed to different ecological conditions, or they may be inherent, perhaps serving to reduce inbreeding. Thus despite the many intensive studies that have been made of colour-ringed populations of other birds, hardly any brother-sister or parent-child matings have been recorded, and when they did occur, they were less successful than matings between unrelated individuals (Lack 1954, Greenwood et al. 1978).

*Acknowledgments*

I am grateful to the British Trust for Orinithology for use of ringing data, and to the Nature Conservancy Council for financing part of this work.

*Literature Cited*

Cavé, A. J. 1968. The breeding of the Kestrel, *Falco tinnunculus* L., in the reclaimed area Oostelijk Flevoland. *Netherlands J. Zool.* 18:313–407.

Fiuczynski, D. 1978. Zur Populationsökologie des Baumfalken (*Falco subbuteo* L., 1758). *Zool. Jb. Syst. Bd.* 105:193–257.

Galushin, V. 1974. Synchronous fluctuations in populations of some raptors and their prey. *Ibis* 116:127–34.

Greenwood, P. J., Harvey, P. H., and Perrins, C. M. 1978. Inbreeding and dispersal in the Great Tit. *Nature* 271:52–4.

Henny, C. J., and van Velzen, W. T. 1972. Migration patterns and wintering localities of American Ospreys. *J. Wildl. Manage.* 36:1133–41.

Höglund, N. 1964. Der Habicht *Accipiter gentilis* Linné in Fennoscandia. *Viltrevy* 2:195–270.

Lack, D. 1954. *The natural regulation of animal numbers.* Oxford: Clarenden.

Matray, P. F. 1974. Broad-winged Hawk nesting and ecology. *Auk* 91:307–24.

Mead, C. J. 1973. Movements of British raptors. *Bird Study* 20:259–86.

Newton, I. 1975. Movements and mortality of British Sparrowhawks. *Bird Study* 22:35–43.

Nielson, B. P. 1977. Migratory habits and dispersal of Danish Buzzards *Buteo buteo. Dansk Orn. Foren. Tidsskr.* 71:1–9.

Olsson, O. 1958. Dispersal, migration, longevity and death causes of *Strix aluco, Buteo buteo, Ardea cinerea* and *Larus argentatus. Acta Vertebratica* 1:91–189.

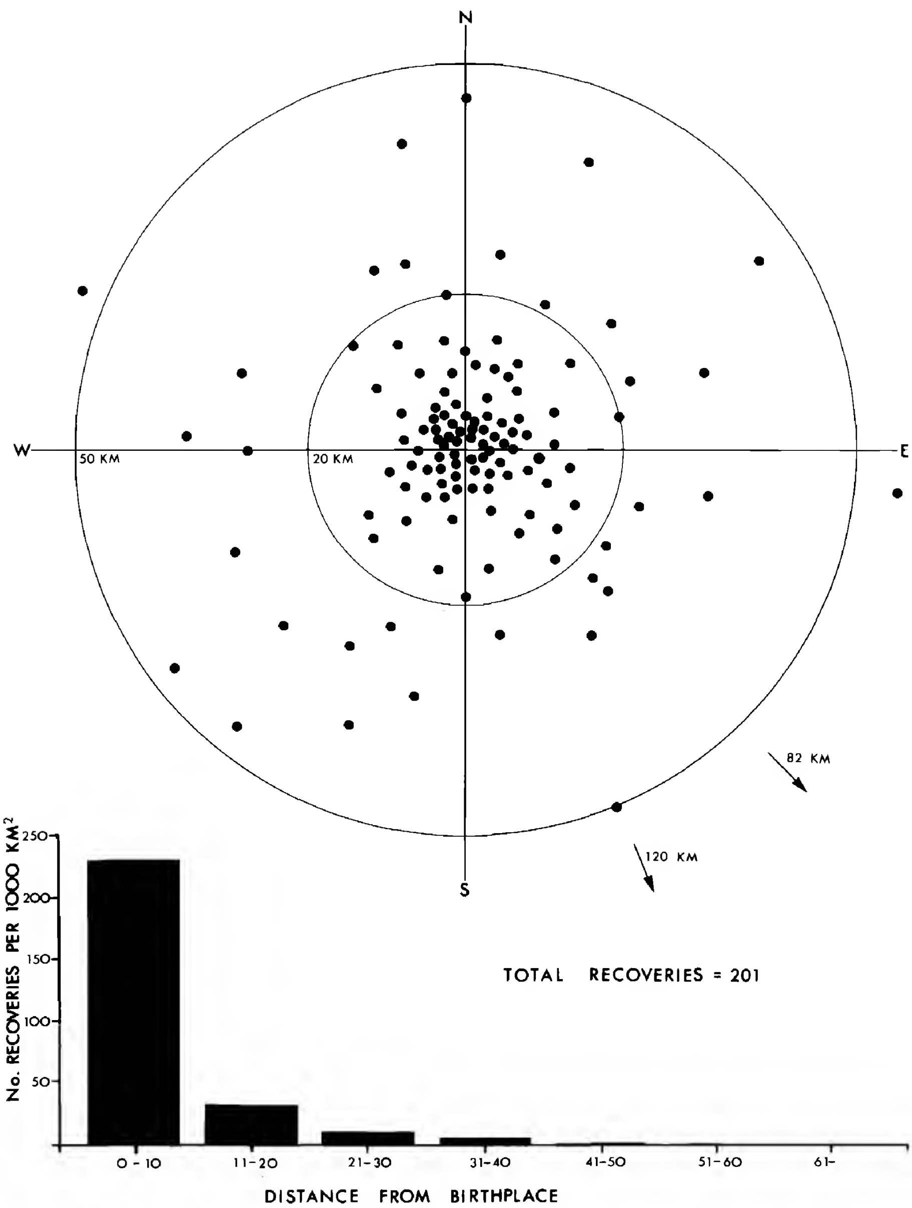
Osterlof, S. 1951. Fiskgjusens, *Pandion haliaetus* (L), flyttning. *Var Fågelvårld* 10:1–15.

Osterlof, S. 1977. Migration, wintering areas, and site tenacity of the European Osprey *Pandion h. haliaetus* (L). *Ornis Scand.* 8:61–78.

Schifferli, A. 1965. Vom Zugverhalten der in der Schweiz brutenden Turmfalken *Falco tinnunculus,* nach den Ringfunden. *Orn. Beob.* 62:1–13.

Schifferli, A. 1967. Vom Zug Schweizerischer und Deutscher Schwarzer Milane nach Ringfunden. *Orn. Beob.* 64:34–51.

Snow, D. W. 1968. Movements and mortality of British Kestrels *Falco tinnunculus. Bird Study* 15:65–83.


N
W
E
S
50 KM
20 KM
82 KM
120 KM
TOTAL RECOVERIES = 201
No. RECOVERIES PER 1000 KM²
250
200
150
100
50
0 - 10
11-20
21-30
31-40
41-50
51-60
61-
DISTANCE FROM BIRTHPLACE

# DECOMPOSITION OF RAPTOR PELLETS

**by**
**James R. Philips**
**and**
**Daniel L. Dindal**
**Department of Forest Zoology**
**State University of New York**
**College of Environmental Science and Forestry**
**Syracuse, New York 13210**

*Abstract*

Decomposing pellets from Great Horned Owls were studied during the summer and fall of 1973. After four months, pellets weighed 38–89 percent of their initial dry weight. Thirteen species of fungi were isolated from the pellets. Funnel extraction yielded 3,665 invertebrates from 75 pellets. The most important invertebrates in pellet decomposition appear to be the trogid beetles and the tineid moths. Raptor pellets serve as a feeding, breeding, and shelter site for many invertebrates, including predators, parasites, fungivores, and saprovores.

*Introduction*

Indigestible material is quite commonly regurgitated by birds in the form of roughly oval to cylindrical pellets. Such regurgitation is known to occur in 330 species in more than 60 families, according to a survey made by The International Bird Pellet Study Group (Glue 1973). Among them are such birds as jays, flycatchers and thrushes, as well as hawks and owls (Simmons 1973, Tucker 1944). Raptor pellets generally consist of fur, feathers, bone, scales, chitin, and other prey remains, densely packed and held together by mucus secreted from the digestive tract which dries and hardens soon after egestion. In some cases, pellets of wax (Honey Buzzard, *Pernis apivorus,* Meinertzhagen 1959) or even soil (Kestrel, *Falco tinnunculus,* Davis 1975) may be found. Pellets are also ejected by other vertebrates, including some mammals, reptiles, and amphibians (Hanson pers. comm., Dobroruka 1973).

Pellets provide data on avian food habits and prey populations, but many other aspects are of interest as well. Smith and Richmond (1972), Duke et al. (1973, 1975, 1976), and others have examined the physiology of pellet formation and regurgitation. Dobrokhotov and Litvin (1971) studied time-related dynamics of Kestrel pellet formation by measuring pellet radioactivity after the raptor ingested mice containing $P^{32}$. Raptor pellets may also play a role in the spread of diseases such as sylvatic plague, since they are temporarily infective if diseased prey has been eaten (Jellison 1939). Plague antigens can be detected much longer than the plague microbe itself in pellets, and pellet analysis has been proposed as one of the best methods of detecting epizootic plague infestations (Lobachev et al. 1971, Lobachev and Shenbrot 1974).

Pellet decomposition has been given very little attention. Some authors have reported that pellets may remain intact for many years (Brooks 1929, Prestt and Wagstaffe 1973). Others have found that pellets are broken down in weeks or months (Wilson 1938, Marti 1974). Watling (1962, 1963) studied fungal succession on Kestrel



Raptor Research 13(4):102–111

(*Falco tinnunculus*) pellets and isolated 51 species of fungi and one alga. Hubálek (1974) isolated many fungal species from owl pellets. The invertebrate fauna reported from pellets is limited to a few insects (table 1). Therefore, the objective of this research was to elucidate the invertebrate microcommunity associated with decomposition of owl pellets. The concept of microcommunity as presented by Dindal (1973a) was assumed in the study.

**Table 1. Insect Fauna of Raptor Pellets**

| Order<br>Family | References |
|---|---|
| Coleoptera | |
| Dermestidae Carpet beetles | Wallace, 1948 |
| *Dermestes spp.* | Simmons, 1971 |
| Silphidae Carrion beetles | Hanson, pers. comm. |
| Trogidae Skin beetles | Petersen, 1960 |
| *Trox erinaceous* J. Lec. | Davis, 1909 |
| *Trox foveicollis* Harold | Vaurie, 1955 |
| *Trox plicatus* Robinson | Vaurie, 1955 |
| *Trox scaber* (L.) | Davis, 1909 |
| *Trox spinulosus simi* Robinson | Vaurie, 1955 |
| *Trox striatus* Mels. | Vaurie, 1955 |
| *Trox variolatus* Mels. | Dillon and Dillon, 1972; Vaurie, 1955 |
| Diptera | |
| Anthomyiidae Anthomyid or latrine flies | |
| *Fannia aerea* (Zetterstedt) | Aubrook, 1939 |
| *Hydrotaea occulta* (Meigen) | Aubrook, 1939 |
| Scatophagidae Manure-feeding flies | |
| *Scatophaga squalida* Meigen | Aubrook, 1939 |
| Scenopinidae Window flies | |
| *Scenopinus* sp. | de Joannis, 1899 |
| Hymenoptera | |
| Braconidae Braconid parasitoid wasps | |
| *Phaenocarpa ruficeps* (von Es.) | Aubrook, 1939 |
| Lepidoptera | |
| Tineidae Clothes moths | Morton et al., 1977; Vernon, 1972 |
| *Monopis ferruginella* (Hubner) | Hinton, 1956 |
| *Monopis rusticella* (Clerck) | Nurse, 1906; Buxton, 1914; Elton, 1966 |
| *Monopis weaverella* Scott | Elton, 1966 |
| *Tinea pellionella* (L.) | de Joannis, 1899 |
| *Tineola bisselliela* (Hummel) | de Joannis, 1899 |
| *Trichophaga* sp. | Moon, 1940 |
| *Trichophaga tapetzella* (L.) | de Joannis, 1899; Forbes, 1923; Baer, 1924; Davis (cited by Lutz, 1948) |

### *Methods*

Rats (*Rattus norvegicus*) were fed to five Great Horned Owls (*Bubo virginianus*). Pellets and pellet fragments were collected as soon as possible after regurgitation. They were dried in an oven at 60°C for 24 hours. Dry weight and volume were

measured. The dry pellets were placed in 6-mm mesh nylon bags and frozen. On 3 July 1973, 90 "pellet bags" were set out in a maple-oak stand at our College's Forest Experiment Station, Lafayette Road, Syracuse, New York. The pellets varied in weight from 3.08 to 11.47 g (av. 6.06); length ranged from 33 to 86 mm (av. 49.71) and width, from 20 to 34 mm (av. 25.11).

Six pellets were removed every 8 days for 4 months. Five pellets were placed in modified Tullgren funnels for extraction of invertebrates. As the pellets air-dried, desiccation drove out the invertebrates, which fell into a collecting jar containing an alcohol and glycerin solution placed at the base of the funnel. The remaining pellet was used for culturing of fungi and invertebrates. Portions of the pellet were incubated on moist filter paper in a petri dish in the dark at 25°C. When insects hatched, they were preserved in alcohol. As fungal growth became evident, pieces of the pellet were transferred onto mycobiotic agar. The other half of the pellet was used for culturing of fungi by means of the soil-dilution agar plate method (Menzies 1965). Dilutions from $10^{-4}$ to $10^{-6}$ were used with preparations of mycobiotic and malt agars.

*Results and Discussion*

After 4 months' exposure to field conditions, pellets weighed from 38.03 to 89.53 percent of their initial dry weight, averaging 62.87 percent (fig. 1). Decomposition rates were highly variable because of differences in size, composition, microenvironment, and faunal and floral colonization of pellets.

*Physical Factors.* Weather is a major factor in pellet decomposition. Rain flattens the pellet, dissolves the mucus, washes hair away from bones near the surface of the pellet, and helps create entry holes for invertebrates. Freezing and thawing are also important (Wilson 1938).

*Faunal Microcommunity.* Fresh moist pellets attract flies, such as Calliphoridae and Anthomyiidae, which deposit their eggs on the pellets. Such flies do not appear to be attracted to dried or older pellets. Other flies may be found on older, moist pellets; however, pellets may at times represent islands of moisture on the soil litter surface and attract cryptozoans, such as sowbugs and earthworms. Snails and slugs can also be found on pellets, and the large slug *Limax maximus* often leaves a trail of mucus on pellets it has visited nocturnally. Various transient species, such as ants, centipedes, millipedes, and spiders, also visit pellets, as well as occasional hungry mammals (Wilson 1938, Fleay 1968) and industrious pack rats (Griffin 1976, Long and Kerfoot 1963). Pellets support large populations of protozoa and nematodes, and even tardigrades may be present.

Pellets serve as habitat for beetles such as Leptodiridae and Staphylinidae. Various parasitic wasps find pellets to be a source of hosts. Predatory, parasitic, fungivorous, and saprophagous mites all were found. Akimov and Shehur (1972) have shown that the acarid mites *Tyrophagus putrescentiae* (Schrank), *Glycyphagus domesticus* (Deg.), and *Rhizoglyphus echinopus* (Fum. et Rob.) cannot digest keratin but feed on the lipids associated with keratinous substances such as feathers. However, other possible food sources are present, on feathers and pellets. Also, we have often found larvae, nymphs, and adults of *T. putrescentiae*, on pellets, with alimentary tracts filled with hyphae and fungal spores.

The two most important pellet invertebrate decomposers are the tineid moths and

the trogid beetles. The larvae of the Tineidae, or clothes moths (fig. 2), eat hair and feathers, and we have found over 60 of them in a single pellet. Pellets sometimes appear to be covered ventrally with a centimeter or more of debris. Actually this is a thin layer of soil and moth excreta covering many cases of silk constructed by the larvae. These cases range from 7 to 18 mm long by 2 mm wide, and the larvae feed and pupate within them. The open end of the case is in the pellet and the case resembles a small "sock" sticking out of the pellet. In decomposed pellets, the silken network of these moth cases may be all that holds the remaining bones together. Fly larvae of the genus *Scenopinus* prey on tineid larvae in pellets (de Joannis 1899).

The trogid beetles also feed on hair and feathers, and their larvae burrow into the soil beneath the pellet. The burrows may be 30 mm deep by 2 mm wide, and they may be lined with hair for the upper 20 mm. Trogid beetles also serve as transportation for uropodine and macrochelid mites (Sixl 1971). Many mites attach themselves to insects for transportation from one site to another. This relationship is known as phoresy. A mesostigmatic mite *Macrocheles penicilliger* (B.) has been reported phoretic on *Trox scaber* in owl nests in England (fig. 3). We have found it on *Trox variolatus* in pellets and rat carrion in central New York. In addition we have found nematodes that are also phoretic on the phoretic *Macrocheles* mite (fig. 3). There are several other published records of this type of nematode phoresy (Dindal 1973b, Ramsay 1970).

Funnel extraction data for both tineid moths and trogid beetles was found to be unreliable because their cases provide considerable protection against desiccation. The trogid beetles are often found beneath the pellets—adults in the litter, and larvae in the soil. Millipedes, sowbugs, and earthworms were also observed on pellets more frequently than the extraction data indicates (table 2).

Perhaps the most surprising find was a specimen of *Radfordia*. This prostigmatic mite is a small mammal ectoparasite which feeds in the bases of hair follicles (Krantz 1971). The specimen was in good condition but was probably dead and accidentally fell into the collecting jar during extraction. However, another specimen was obtained in an extraction of fresh Great Horned Owl pellets. These findings bring up the question of whether ectoparasites may occasionally survive in the environment of a raptor's stomach long enough to be regurgitated alive in a pellet. Chmielewski (1970) studied the passage of astigmatic mites through the alimentary canal of mice, sparrows, and hens. Survival rates of some species varied from 1–7 percent. Survivors included individuals of all stages although eggs and resting stages were more resistant. Other parasites may also occasionally be found in pellets. Bond (1940) reported Great Horned Owl pellets in Nevada containing chicken ticks, *Argas persicus* (Oken); for example, one pellet contained a gopher skull and 42 ticks. Also, roundworms such as *Porrocaecum* and *Ascaridia* are sometimes egested with pellets (Cooper 1972). In addition to vertebrate parasites, we have periodically found insect and acarine parasites of other invertebrates on pellets.

*Pellet Flora.* Thirteen species of fungi were isolated from the pellets (table 3). Other species of fungi were observed on the pellets, but culture attempts failed. The most important species (as judged by visible growth) are *Trichoderma* sp. and *Chrysosporium tropicum* Carmichael. Large green patches of *Trichoderma* at times covered up to 20 percent of the pellet surface. Most pellets had some surface growth of *Chrysosporium*, and some appeared extremely white as the fungus took over as much as

**Table 2. Invertebrates from Great Horned Owl Pellets**

| | no. pellets (75) | no. of specimens | max. no. on one pellet |
|---|---|---|---|
| Prostigmata | 73 | 1,840 | 156 |
| Collembola | 55 | 884 | 84 |
| Oribatei | 63 | 369 | 57 |
| Mesostigmata | 53 | 241 | 42 |
| Lepidoptera | 43 | 194 | 22 |
| Astigmata | 18 | 27 | 6 |
| Coleoptera | 14 | 26 | 9 |
| Hymenoptera | 9 | 17 | 6 |
| Gastropoda | 9 | 13 | 2 |
| Diptera | 7 | 12 | 2 |
| Isopoda | 9 | 11 | 2 |
| Homoptera | 8 | 8 | 1 |
| Araneida | 7 | 8 | 2 |
| Chilopoda | 3 | 4 | 2 |
| Thysanoptera | 2 | 4 | 3 |
| Psocoptera | 3 | 3 | 1 |
| Diplopoda | 1 | 1 | 1 |
| Oligochaeta | 1 | 1 | 1 |
| Pauropoda | 1 | 1 | 1 |
| Symphyla | 1 | 1 | 1 |
| Total | | 3,665 | |

| | | | |
|---|---|---|---|
| Av. no./pellet | 48.87 | Mites | 67.59% |
| Av. no./g dry wt | 9.25 | Insects | 31.32% |
| Max. no./g dry wt on one pellet | 48.00 | Others | 1.09% |

**Table 3. Fungi from Great Horned Owl Pellets**

*Alternaria* sp.
**Aspergillus flavus* Link
*Aspergillus fumigatus* Fresenius
**Aspergillus niger* Van Tieghem
*Aspergillus* sp.
*Chaetomium* sp.
*Chrysosporium tropicum* Carmichael
**Fusarium roseum* section
*Paecilomyces* sp.
*Rhizopus* sp.
*Sporotrichum* sp.
*Trichoderma* sp.

*species not previously reported from pellets

75 percent of the surface (fig. 4). *Chrysosporium* is a keratinophilic fungus which attacks hair with the aid of penetrating bodies (Carmichael 1962). This genus is common on bird feathers and in their nests (Pugh 1966, 1972; Pugh and Evans 1970; Otcenášek et al. 1967; Rees 1967; Hubálek 1974. While *Aspergillus fumigatus*, the cause of aspergillosis in birds, was found, its occurrence in pellets does not appear to be an unusual source of infection since the fungus is so widespread.

*Summary*

Pellets may serve as a site of breeding, feeding, and shelter for many invertebrates and as a substrate for growth of a variety of fungi. Some invertebrates consume various pellet components such as the lipids of hair and feathers while others feed on the fungi. Still other predatory or parasitoid invertebrates are attracted to pellets where they afflict some of the "pioneer" invertebrates.

Pellets may be found in many habitats. They are produced by many avian and other vertebrate species, and they differ widely in composition depending upon the prey species. For these reasons pellets are excellent instructional tools since they illustrate so many aspects of ecology. Much remains to be learned about pellets as habitats for microbe and invertebrate microcommunities.

*Acknowledgments*

We thank Jack Gray for allowing us to use two of the owls of the Burnet Park Zoo, Syracuse, and Dr. A. A. Padhye of the Center for Disease Control, Atlanta, Georgia, for identifying the fungi. Also, Dr. Roy A. Norton graciously aided in the identification of the mite species we collected.

*Literature Cited*

Akimov, E. A., and L. E. Shehur. 1972. Features of the nutrition of the grain mites *Glycyphagus domesticus* (Deg.) and *Tyrophagus putrescentiae* (Schr.) and the root mite *Rhizoglyphus echinopus* (Fum. et Rob.) on some proteinoids. (In Russian, English summary). *Vestnik Zool.* 6(6):45–48.

Aubrook, E. W. 1939. Insects bred from owl pellets. *Entomol. Mon. Mag.* 75:88.

Baer, W. 1924. Biologische Beobachtungen an Kleidermotten. *Naturw. Korresp.* 2:122–123.

Bond, R. M. 1940. Food habits of horned owls in the Pahranagat Valley, Nevada. *Condor* 42(3):164–165.

Brooks, A. 1929. On pellets of hawks and owls. *Condor* 31:222–223.

Buxton, P. A. 1914. Habit of *Tinea rusticella*. *Entomol. Rec.* 26:143.

Carmichael, J. W. 1962. *Chrysosporium* and some other aleuriosporic hyphomycetes. *Canadian J. Bot.* 40:1137–1174.

Chmielewski, W. 1970. The passage of mites through the alimentary canal of vertebrates. *Ekol. Pol. Ser. A.* 18(35):741–756.

Cooper, J. E. 1972. Hawks and parasites. *Hawk Chalk* 11:31–35.

Davis, T. A. W. 1975. Food of the kestrel in winter and early spring. *Bird Study* 22(2):85–91.

Davis, W. T. 1909. Owl pellets and insects. *J. New York Entomol. Soc.* 17(2):49–51.

Dillon, E. S., and L. S. Dillon. 1961. *A manual of common beetles of Eastern North America*. Dover Publications, New York. 2 vols. 894 pp.

Dindal, D. L. 1973a. Microcommunities defined. Pages 2–6 in D. L. Dindal (ed.), *Soil Microcommunities I,* Proc. First Conf. Nat. Tech. Information Serv. USAEC. CONF-711076, Springfield, Virginia.

Dindal, D. L. 1973b. Review of symbiotic relationships in soil invertebrates. Pages 227–256 in D. L. Dindal (ed.), *Soil Microcommunities I.,* Proc. First Conf. Nat. Tech. Information Serv. USAEC. CONF-711076, Springfield, Virginia.

Dobrokhotov, B. P., and V. Yu. Litvin. 1971. Radioactivity of pellets of *Falco tinnunculus* L. after feeding on mice containing $P^{32}$. (In Russian, English summary). *Zool. Zh.* 50:1591–1592.

Dobroruka, L. J. 1973. Pellet formation in the Japanese giant salamander. *Int. Zoo. Yrbk.* 13:158.

Duke, G. E., J. C. Ciganek, and O. A. Evanson. 1973. Food consumption and energy, water and nitrogen budgets in captive Great Horned Owls (*Bubo virginianus*). *Comp. Biochem. Physiol.* 44(A):283–292.

Duke, G. E., O. A. Evanson, and A. Jegers. 1976. Meal to pellet intervals in 14 species of captive raptors. *Comp. Biochem. Physiol.* 53(A):1–6.

Duke, G. E., A. A. Jegers, G. Loff, and O. A. Evanson. 1975. Gastric digestion in some raptors. *Comp. Biochem. Physiol.* 50(A):649–656.

Elton, C. S. 1966. *The pattern of animal communities.* Wiley, New York. 432 pp.

Fleay, D. 1968. *Nightwatchmen of bush and plain.* Taplinger, New York. 163 pp.

Forbes, W. T. M. 1923. *The Lepidoptera of New York and neighboring states.* Primitive forms, Microlepidoptera, Pyraloids, Bombyces. Mem. Cornell Agric. Exp. Sta. No. 68. 729 pp.

Glue, D. E. 1973. Owl pellets. Pages 193–197 in J. A. Burton (ed.), *Owls of the world.* E. P. Dutton, New York.

Griffin, C. R. 1976. A preliminary comparison of Texas and Arizona Harris' Hawks (*Parabuteo unicinctus*) populations. *Raptor Res.* 10(2):50–54.

Hinton, H. E. 1956. The larvae of the species of Tineidae of economic importance. *Bull. Entomol. Res.* 47:251–346.

Hubálek, Z. 1974. The distribution patterns of fungi in free-living birds. *Acta Sc. Nat. Brno* 8(9):1–51.

Jellison, W. L. 1939. Sylvatic plague: Studies of predatory and scavenger birds in relation to its epidemiology. U.S. Public Health Service. *Public Health Reports* 54:792–798.

Joannis, J. de. 1899. Note sur quelques Microlepidoptères dont les chenilles se nourissent de poils d'animaux. *Bull. Soc. Entomol. Fr.* 1899:248–250.

Krantz, G. W. 1971. *A manual of acarology.* Oregon State Univ. Book Stores, Inc., Corvallis, Oregon. 335 pp.

Lobachev, V. S., M. E. Levi, and M. M. Levschitz. 1971. The preservation of a specific antigen of a plague-causing agent in the food pellets of predatory birds. (In Russian, English summary). *Zool. Zh.* 50:1593–1595.

Lobachev, V. S., and G. Shenbrot. 1974. Food of the Little Owl in the North Aral Sea area. (In Russian). *Ornitologiya* 11:382–390.

Long, C. A., and W. C. Kerfoot. 1963. Mammalian remains from owl-pellets in eastern Wyoming. *J. Mammal.* 44(1):129–131.

Lutz, F. E. 1948. *Field book of insects.* G. P. Putnam's Sons, New York. 510 pp.

Marti, C. D. 1974. Feeding ecology of four sympatric owls. *Condor* 76(1):45–61.

Meinertzhagen, R. 1959. *Pirates and predators.* Oliver and Boyd, London. 230 pp.

Menzies, J. D. 1965. Fungi. Pages 1502–1505 in C. A. Black (ed.), *Methods of soil analysis.* Part 2. Am. Soc. Agronomy Inc., Madison, Wisconsin.

Moon, E. L. 1940. Notes on hawk and owl pellet formation and identification. *Trans. Kansas Acad. Sci.* 43:457–466.

Morton, S. R., M. Happold, A. K. Lee, and R. E. MacMillan. 1977. The diet of the barn owl, *Tyto alba,* in southwestern Queensland. *Australian Wildl. Res.* 4:91–97.

Nurse, C. G. 1906. Food of *Monopis rusticella. Entomologist* 39:160.

Otcenášek, M., K. Hudec, Z. Hubálek, and J. Dvorák. 1967. Keratinophilic fungi from the nests of birds in Czechoslovakia. *Sabouradia* 5:350–354.

Peterson, A. 1960. *Larvae of insects.* Part 2. Edwards Bros., Ann Arbor, Michigan. 416 pp.

Prestt, I., and R. Wagstaffe. 1973. Barn and bay owls. Pages 42–60 in J. A. Burton, (ed.), *Owls of the world.* E. P. Dutton, New York.

Pugh, G. J. F. 1966. Associations between birds' nests, their pH, and keratinophilic fungi. *Sabouradia* 5:49–53.

———. 1972. The contamination of birds' feathers by fungi. *Ibis* 114:172–177.

Pugh, G. J. F., and M. D. Evans. 1970. Keratinophilic fungi associated with birds. I. Fungi isolated from feathers, nests, and soils. *Trans. British Mycol. Soc.* 54(2):233–240.

Ramsay, G. W. 1970. Mites with phoretic nematodes. *New Zealand Entomol.* 4(4):91–92.

Rees, R. G. 1967. Keratinophilic fungi from Queensland. II. Isolation from feathers of wild birds. *Sabouradia* 6:14–18.

Simmons, G. E. 1971. Patterns of life in woodland communities. 8. Bird pellets. *Quarterly J. Forestry.* 65:224–231.

——— 1973. The study of bird pellets. *Country Side* 22:116–122.

Sixl, W. 1971. Ein Beitrag zur Kenntnis der Phoresie. *Mitt. naturwiss. Ver. Steiermark.* 100:405–406.

Smith, C. R., and M. E. Richmond. 1972. Factors influencing pellet egestion and gastric pH in the Barn Owl. *Wilson Bull.* 84:179–186.

Tucker, B. W. 1944. The ejection of pellets by passerine and other birds. *British Birds* 38:50–52.

Vaurie, P. 1955. A revision of the genus *Trox* in North America (Coleoptera, Scarabaeidae). *Bull. American Mus. Nat. Hist.* 106(1):1–89.

Vernon, C. J. 1972. An analysis of owl pellets collected in southern Africa. *Ostrich* 43:109–124.

Wallace, G. J. 1948. *The Barn Owl in Michigan.* Its distribution, natural history and food habits. Michigan State Coll. Agric. Exp. Sta. Tech. Bull. 208. 61 pp.

Watling, R. 1962. Fungal succession on kestrel pellets. *Naturalist* 41–43.

Watling, R. 1963. The fungal succession on hawk pellets. *Trans. British Mycol. Soc.* 46(1):81–90.

Wilson, K. A. 1938. Owl studies at Ann Arbor, Michigan. *Auk* 55:187–197.

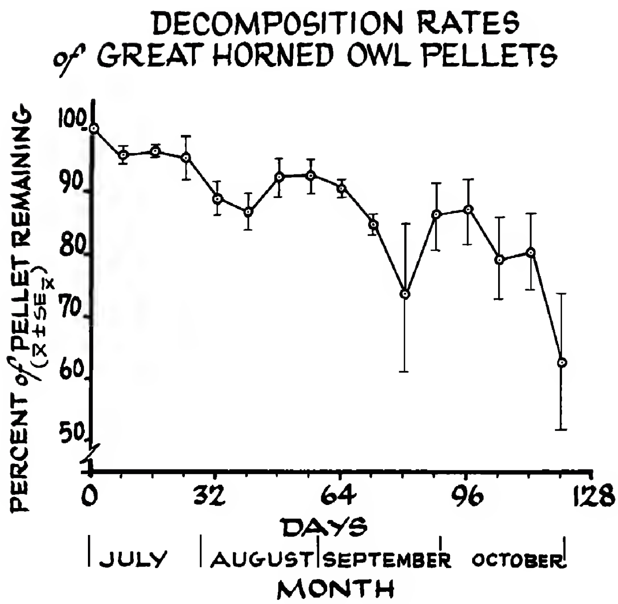



Figure 1. Decomposition rate of Great Horned Owl pellets.

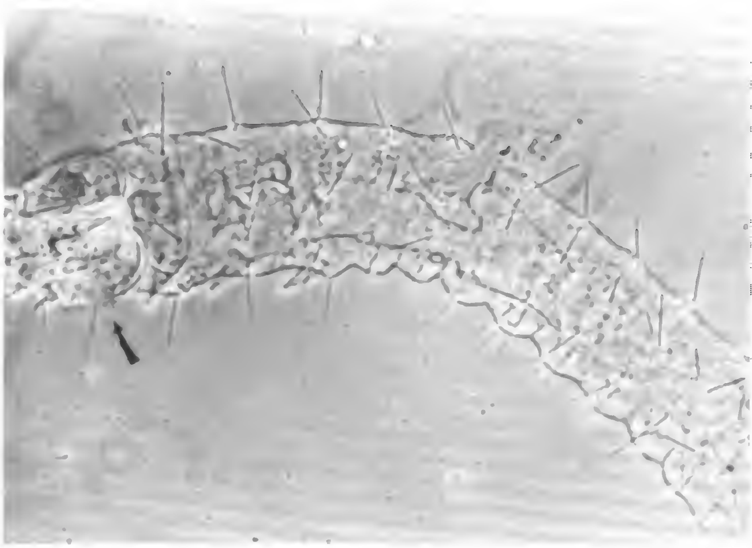


Figure 2. Larva of clothes moth, Tineidae (head capsule indicated by arrow).

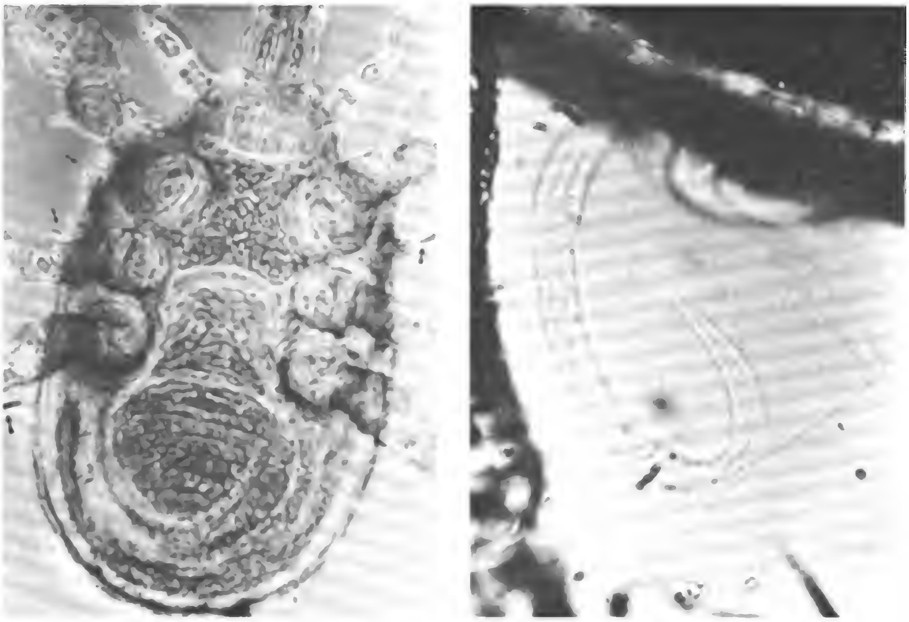


Figure 3. Phoretic nematodes (indicated by arrows) attached to mesostigmatic mite *Macrocheles penicilliger.*

Figure 4. Growth of the white keratinophilic fungus, *Chrysosporium tropicum,* on surface of decomposing Great Horned Owl pellet.

# OBSERVATIONS ON THE BEHAVIOR OF WINTERING BALD EAGLES

by
**Howard I. Russock**
**Department of Biological and Environmental Sciences**
**Western Connecticut State College**
**Danbury, Connecticut 06810**

*Abstract*

The behavior of four Bald Eagle (*Haliaeetus leucocephalus*) was studied in western Connecticut during the winter of 1976–77. The eagles congregated below a hydroelectric dam which killed and injured large numbers of fish. The Bald Eagles ate these fish almost exclusively when in the vicinity of the dam and were never observed to hunt the waterfowl which also congregated in the area. Crows were observed to mob or harass the eagles on ten occasions. The eagles exhibited soaring behavior on seventeen occasions. Soaring has been considered an aspect of play and courtship; evidence is presented which suggests that soaring may also be involved in agonistic interactions.

*Introduction*

The behavior of the Bald Eagle (*Haliaeetus leucocephalus*) has been studied many times. Most of these investigations have concentrated on reproductive and nesting behavior. Comparatively few studies have dealt with migratory Bald Eagles on their wintering grounds (Southern 1963, 1964; Hancock 1964; Ingram 1965; Lish 1973; Platt 1976), and fewer still have concentrated on the behavior of wintering eagles.

This paper is a report of one winter of observations on the behavior of Bald Eagles in western Connecticut. The eagles congregated below the Shepaug Hydroelectric Dam on the Housatonic River; the dam's generators kept the otherwise frozen river open and killed or injured large numbers of fish.

The National Audubon Society Continental Bald Eagle Project has reports of Bald Eagles wintering in the Shepaug Dam area as early as December 1963, with the possible existence of an active nest in the area until 1966. Local residents have reported observing wintering Bald Eagles in the area as early as 1953; there are also reports of Bald Eagles wintering along the Connecticut River near Essex.

*Study Area and Methods*

The Bald Eagles were observed in the vicinity of the Shepaug Hydroelectric Dam on the Housatonic River, approximately 4.6 km north of Newtown, Connecticut. Most observations were made on the property of the Connecticut Light and Power Company, located on the north shore of the river and extending for 0.8 km east (downstream) of the dam; additional observations were made on a public road which follows the north side of the river for an additional 3.4 km. Above the dam is a lake surrounded by undeveloped woodland.

The subjects were observed with field binoculars (7×35) and a telescope (80–160X); observations were dictated into a tape recorder. This report covers more than 50 hr of observation.



Raptor Research 13(4):112–115

*Results and Discussion*

Four Bald Eagles (one adult, three immatures) were observed. According to the plumage classifications of Bent (1937) and Southern (1964), the immature eagles were approximately 2–3 (A), 3–4 (B), and 4 years old (C). The first observation of each eagle was between 14 December 1976 and 3 January 1977. The eagles were observed for the last time between 23 February 1977 and 11 March 1977.

The river was frozen from 29 December 1976 to 24 February 1977, except for an area immediately below the dam when the dam's generators were operating. The lake above the dam was frozen from before the eagles' arrival until after they left. The departure of the eagles coincided with a period of consistently above-freezing temperatures which opened the river.

The eagles normally arrived at the dam from the direction of the woodland above the dam and flew in the direction of the woodland upon leaving the feeding area. Presumably their roosting site(s) were located in this area. Several attempts to locate these sites were, however, unsuccessful.

*Feeding.* With one exception, fish were the only observed prey of the eagles. Fish are the preferred food of Bald Eagles (Broley 1947, Southern 1966, Mc'Clelland 1973, Dunstan and Harper 1975, Ofelt 1975), and wintering eagles have been reported to congregate near dams in many parts of the country (Sprunt 1961, Southern 1963, Ingram 1965, Spencer 1976).

The eagles were observed to make swooping dives to the river to catch fish on 69 occasions, 33 of which were successful (47.8%). However, the two older birds (the adult and immature C) were successful 62.5% (20/32) of the time, while the two younger birds were successful only 35.1% (13/37) of the time ($p < 0.025$, Chi-Square Test). The species of fish they were catching was not determined; dead fish washed onto shore included White Perch (*Roccus americana*), Trout (*Salvelinus spp.*), and Bass (*Micropterus spp.*).

*Interspecific Interactions.* The large number of fish killed or injured by the dam's generators attracted many other birds to the area. Hundreds of Common Crow (*Corvus brachyrhynchos*) were present on all observation days as was a mixed-species flock of 50–200 Herring, Great Black-backed, and Ring-billed Gull (*Larus argentatus, L. marinus, L. delawarensis*). In addition, small numbers of the Canada Goose (*Branta canadensis*), the Mallard (*Anas platyrhynchos*), the Common Merganser (*Mergus merganser*), and the Great Blue Heron (*Ardea herodias*) were often present. The eagles were never observed hunting the waterfowl, and an eagle was observed scavenging on waterfowl (a gull) on only one occasion. The apparent lack of interest of the eagles in the waterfowl is surprising because, next to fish, waterfowl are the preferred food of Bald Eagles and are often their primary food during the winter (Oberholser 1906, Brooks 1922, Bent 1937, Murrie 1940, Retfalvi 1970). However, Spencer (1976) has reported that Bald Eagles ignore waterfowl when fish are available, and Munro (1938) and Southern (1964) have reported cases of waterfowl ignoring Bald Eagles which were feeding nearby.

Crows were observed harassing Bald Eagles on eight occasions and mobbing an eagle on two occasions. Harassment and mobbing were differentiated on the basis of length of the interaction and the number of crows involved. The eight interactions classified as harrassments involved one to six crows ($\bar{X} = 3.0 \pm 1.6s$) and lasted 1–5 min ($\bar{X} = 2.6 \pm 1.4s$ min). Five harassments involved a perched eagle, and three occurred when an eagle was in the air; in two cases the eagle had a fish which the crows were apparently trying to

take. All harassments were directed against the immature eagles. Crows were never observed harassing or mobbing the adult eagle.

Several studies have reported crows nesting or feeding near Bald Eagles (Baily 1927, Howell 1937, Southern 1964, Ingram 1965, Erskine 1968, Spencer 1976), and several others have reported crows harassing Bald Eagles or attempting to get their food (Herrick 1932, Hausman 1948, Musselman 1949, Retfalvi 1970, Weekes 1975).

Both instances of mobbing involved one immature eagle (C). The first case occurred on the first day the bird was observed and quite possibly the first time it had entered the study area. It took place while the bird was perched in a tree, lasted 10 min, and involved 100–110 crows. The other observed mobbing occurred two days later while the eagle was circling the study area; it lasted 13 min and involved 26 crows.

*Intraspecific Interactions.* Only one unequivocal agonistic interaction was observed during more than 50 hr of observation. On that occasion an immature eagle (B) was perched on a branch eating a fish when a second immature eagle (C) landed on the same branch and made a pecking movement toward the first bird without making contact. The first bird immediately left the branch, and the second eagle grabbed the fish with its talons and began eating it.

The only other observed intraspecific interactions involved soaring. During soaring two or more eagles swoop down upon each other, often perform rolls in the air in unison, turn over in the air and extend their talons up at the diving eagle, and sometimes try to take sticks from each other in midflight (Bent 1937, Platt 1976). Soaring has been observed as part of play behavior in immature eagles (Bent 1937, Platt 1976), during courtship and early nesting (Herrick 1924, Ingram 1965, Grewe 1966, Brown and Amadon 1968), to signal the presence of a local food source (Sherrod et al. 1976), and during territorial defense (Mattsson 1974, Ogden 1975).

Seventeen separate instances of soaring behavior were observed. Fifteen soaring bouts involved two eagles, and two involved all three immature eagles; the adult eagle was involved in only three of the seventeen bouts. The fourteen soaring bouts involving immature eagles could almost certainly be classified as play. In all cases the eagles took turns chasing each other, and both eagles remained in the feeding area after the bout; five of the fourteen bouts included transferring sticks in midair. However, it is possible that the three soaring bouts involving the adult were agonistic interactions. In all three cases the adult was alone when an immature eagle entered the dam area, and the adult flew up to meet it. In all three cases the adult chased the immature eagle, but the immature eagle never chased or swooped down upon the adult. All three bouts ended with the immature eagle leaving the area. The adult and immature eagles coexisted in the feeding area on many other occasions.

## *Acknowledgments*

I thank the Connecticut Light and Power Company for allowing me access to their property. I also thank Alexander Sprunt IV for providing the National Audubon Society Connecticut Bald Eagle File and John and M. Stoessel Wahl for the use of their Questar telescope. The following people provided me with personal information concerning the present and past history of Bald Eagles in Connecticut: Mrs. Polly Brody, Mr. Donald Hopkins, Mr. Fred King, and Mrs. John Stratton.

## *Literature Cited*

Bailey, A. M. 1927. Notes on the birds of southeastern Alaska. *Auk* 44:1–23, 184–205.

Bent, A. C. 1937. Life histories of North American birds of prey, part I. *U.S. Nat. Mus. Bull.* 167:321–349.

Broley, C. L. 1947. Migration and nesting of Florida Bald Eagles. *Wilson Bull.* 59:3–20.

Brooks, A. C. 1922. Notes on the abundance and habits of the Bald Eagle in British Columbia. *Auk* 39:356–359.

Brown, L., and D. Amadon. 1968. *Eagles, hawks, and falcons of the world,* vol. 1. Hamlyn Publ. Group, Middlesex.

Dunstan, T., and J. Harper. 1975. Food habits of the Bald Eagle in north central Minnesota. *J. Wildl. Manage.* 39:140–143.

Erskine, A. J. 1968. Encounters between Bald Eagles and other birds in winter. *Auk* 85:681–683.

Grewe, A. H. 1966. Some aspects in the natural history of the Bald Eagle, *Haliaeetus leucocephalus,* in Minnesota and South Dakota. Ph.D. dissertation, University of South Dakota (Abstract).

Hancock, D. 1964. Bald Eagles wintering in the Southern Gulf Islands, British Columbia. *Wilson Bull.* 76:111–120.

Hausman, L. A. 1948. *Birds of prey.* Rutgers Univ. Press, New Brunswick, NJ.

Herrick, F. H. 1924. Nests and nesting habits of the American eagle. *Auk* 41:213–231.

———. 1932. Daily life of the American eagle: Early phase. *Auk* 49:307–323, 428–435.

Howell, J. C. 1937. The nesting Bald Eagles of southeastern Florida. *Auk* 54:296–299.

Ingram, T. 1965. Wintering Bald Eagles at Guttenberg, Iowa–Cassville, Wisconsin, 1964–1965. *Iowa Bird Life.* 35:66–78.

Lish, J. W. 1973. Bald Eagles wintering on the Leosho River, Oklahoma. *Bull. Oklahoma Ornithol. Soc.* 6:25–30.

Mattsson, J. P. 1974. Interactions of a breeding pair of Bald Eagles with sub-adults at Sucker Lake, Michigan. Ph.D. dissertation, St. Cloud State University, St. Cloud, MN (Summary).

Mc'Clelland, B. R. 1973. Autumn concentration of Bald Eagles in Glacier National Park. *Condor* 75:121–123.

Munro, J. A. 1938. The northern Bald Eagle in British Columbia. *Wilson Bull.* 50:28–35.

Murrie, O. 1940. Food habits of the northern Bald Eagle in the Aleutian Islands, Alaska. *Condor* 42:198–202.

Mussleman, T. E. 1949. Concentrations of Bald Eagles on the Mississippi River at Hamilton, Illinois. *Auk* 66:83.

Oberholser, H. C. 1906. The North American eagles and their economic relations. *U.S. Bureau Biol. Ser. Bull.* 27:1–31.

Ofelt, C. H. 1975. Food habits of nesting Bald Eagles in southeast Alaska. *Condor* 77:337–338.

Ogden, J. 1975. Effects of Bald Eagle territoriality on nesting Ospreys. *Wilson Bull.* 87:496–505.

Platt, J. B. 1976. Bald Eagles wintering in a Utah desert. *American Birds* 30:783–788.

Retfalvi, L. 1970. Food of nesting Bald Eagles on San Juan Island, Washington. *Condor* 72:358–361.

Sherrod, S. K., C. M. White, and F. S. L. Williamson. 1976. Biology of the Bald Eagle on Amchitka Island, Alaska. *Living Bird,* 15th Annual, pp. 143–182.

Southern, W. E. 1963. Winter populations, behavior, and seasonal dispersion of Bald Eagles in northwestern Illinois. *Wilson Bull.* 75:42–55.

———. 1964. Additional observations on winter Bald Eagle populations: Including remarks on biotelemetry techniques and immature plumages. *Wilson Bull.* 76:121–137.

———. 1966. Utilization of shad as winter food by birds. *Auk* 83:309–311.

Spencer, D. A. 1976. *Wintering of the migrant Bald Eagle in the lower 48 states.* National Agricultural Chemicals Association, Washington, D.C.

Sprunt, A. 1961. An eagle-eyed look at our Bald Eagle. *Audubon Mag.* 63:324–327.

Weekes, F. 1975. Behavior of a young Bald Eagle at a southern Ontario nest. *Canada Field-Nat.* 89:35–40.

# USE OF HUNTING METHODS BY FERRUGINOUS HAWKS IN RELATION TO VEGETATION DENSITY

**by**
**James S. Wakeley**
**School of Forest Resources**
**The Pennsylvania State University**
**University Park, PA 16802**

*Abstract*

To test the hypothesis that hawks increase their foraging efficiency by selecting the most appropriate hunting technique for a particular habitat type, I studied the relative use of 4 hunting methods by 2 Ferruginous Hawks in relation to the density of vegetative cover. No trends in relative use of hunting methods with increasing vegetation density could be detected, indicating either that efficiency of hunting methods did not change with increasing cover density or that factors other than cover density were more important in the hawks' choice of hunting methods for a particular site.

*Introduction*

There is increasing interest in foraging behavior of hawks, especially in factors affecting the selection of habitats for hunting and efficiency of food gathering in various vegetation types. Besides answering important behavioral questions, such information has potential management importance in areas of changing land use.

That hawks use more than one hunting technique, which may differ in energy expenditure and in rate of return, complicates such studies. An individual bird's choice of hunting methods may depend upon its relative efficiency in terms of prey captured per unit of energy expended (Wakeley 1978b). Furthermore, the hunting method which is most efficient in one vegetation type within a bird's home range may be inferior to another method in a different vegetation type. Thus a hawk might increase its overall foraging efficiency by selecting the most appropriate technique for a particular habitat.

This study examines trends in the relative use of 4 hunting methods by 2 Ferruginous Hawk (*Buteo regalis*) in relation to increasing density of vegetative cover, and evaluates the effect of such trends, if any, on foraging efficiency. Wakeley (1978a) determined that cover density was the most important factor influencing the use of

hunting sites by these Ferruginous Hawks, so it seems logical to examine the hawks' use of hunting methods relative to this parameter.

Herein I make no attempt to extrapolate my results on only 2 hawks to the population as a whole. However, a consequence of learning by individuals must ultimately be reflected in the average response of a population.

*Methods*

The study area in southern Idaho and the methods used were described elsewhere (Wakeley 1978a, b). Briefly, the study area consisted of the home ranges of 2 adult male Ferruginous Hawks and was a mosaic of vegetation types including agricultural crops (alfalfa, grains), small pastures, old fields, open shrubland, and bare areas. I measured the density of vegetative cover by a point-quadrat technique and categorized all vegetation into 1 of 4 cover-density classes: absent (<5% vegetative coverage), sparse (5–20% coverage), moderate (20–75% coverage), and dense (>75% coverage).

To determine the use of cover-density classes for foraging, I observed strikes made by the 2 adult male hawks; male 1 was watched in 1974 and male 2, in 1975. Observations were made from a blind during the nestling period. The hawks hunted (1) from the ground, (2) from a perch, (3) from low-altitude (active) flight, and (4) from high-altitude (soaring) flight. All observed strikes were categorized by the hunting method used. I used a graphical technique to look for trends in use of hunting methods with increasing vegetation density (fig. 1). Neither hawk was marked; yet with experience, I had no trouble identifying the birds at a distance and distinguishing them from other hawks in the area. Identification was confirmed when the birds returned to their nests.

*Results*

I witnessed 430 strikes in 1974 and 378 strikes in 1975. Table 1 shows the distribution of these strikes among hunting methods and cover-density classes. In each year, chi-square tests indicated that there were significant differences in relative use of hunting methods in areas of different vegetation density ($P < .01$).

**Table 1. Number of Strikes by Ferruginous Hawks in Relation to Hunting Method and Vegetation Density.*[a]***

| Cover density | Hunting Method | | | | |
|---|---|---|---|---|---|
| | Ground | Perch | Low flight | High flight | Total |
| Absent | 61( 7) | 154( 42) | 70( 47) | 16( 62) | 301(158) |
| Sparse | 9( 3) | 7( 7) | 33( 10) | 16( 1) | 65( 21) |
| Moderate | 7( 0) | 17( 1) | 6( 8) | 17( 0) | 47( 9) |
| Dense | 4( 4) | 0( 56) | 11( 43) | 2( 87) | 17(190) |
| Totals | 81(14) | 178(106) | 120(108) | 51(150) | 430(378) |

[a]Male 1 (1974) without parentheses; Male 2 (1975) within parentheses.

The number of strikes by a hunting method in each cover-density class was expressed as a percentage of total strikes within that class. Despite the significant differences in use of hunting methods within areas of different vegetation density, no consistent trends in use of hunting methods with increasing cover density could be detected (fig. 1).

*Discussion*

I expected to find that the hawks hunted from the ground or from a perch more often in areas of absent or sparse cover than in moderate or dense cover. A hawk's low viewing angle, especially from the typical fencepost perch, would seemingly exaggerate the prey-concealing effect of any vegetation present, making that technique less efficient in moderately or densely vegetated areas. However, this hypothesis was not supported by the results.

The results were apparently not influenced by the relative availability of hunting perches near each habitat type. Hunting perches (wooden fenceposts, telephone poles, juniper trees) were present throughout the study area within or adjacent to all vegetation types. The availability of perches was not quantified, but their number and placement seemed more than adequate to meet the hawks' requirements.

Earlier (Wakeley 1978b), I showed that both hawks increased their overall foraging efficiency by emphasizing their more efficient hunting technique (sit-and-wait hunting from a perch or from the ground). Hawks apparently did not adjust their efficiency further by matching the best hunting method to a particular type of cover, perhaps because there was no difference in relative efficiency of the 4 methods as cover density increased. Another possibility is that some factor other than vegetation density was more important in the hawks' choice of hunting methods for a particular area. Unfortunately, my data are not sufficient to resolve this question.

*Acknowledgments*

This study was supported in part by the Chapman Fund of the American Museum of Natural History and by the Society of Sigma Xi. W. M. Tzilkowski provided statistical advice.

*Literature Cited*

Wakeley, J. S. 1978a. Factors affecting the use of hunting sites by Ferruginous Hawks. *Condor* 80:316–326.

Wakeley, J. S. 1978b. Hunting methods and factors affecting their use by Ferruginous Hawks. *Condor* 80:327–333.

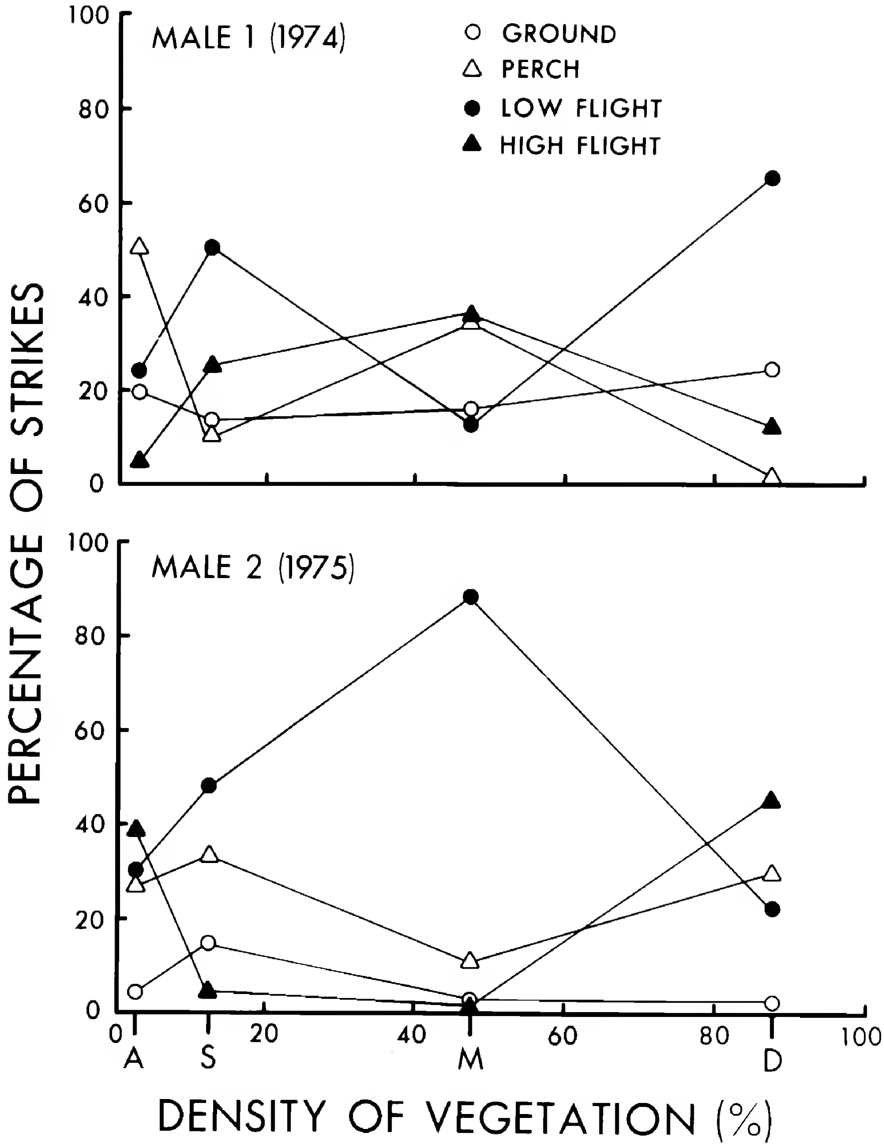



Figure 1. Relationship between density of vegetative cover and relative use of hunting methods by Ferruginous Hawks. Vegetation density is plotted at the midpoint of the cover-density class for absent (A), sparse (S), moderate (M), and dense (D) vegetation.

# COOPER'S HAWK ATTACKS SHARP-TAILED GROUSE

by
**D. L. J. Moyles[1]**
**10315 – 79 St.**
**Edmonton, Alberta**
**T6A 3G7 CANADA**

On 21 April 1976, while observing the morning display of male Sharp-tailed Grouse (*Pedioecetes phasianellus*) on an arena 13 km (8 mi) west of Wainwright, Alberta (lat. 52°49′; long. 110°59′), P. Harris saw a female Cooper's Hawk (*Accipiter cooperii*) attack an adult male sharptail. This attck came approximately one–half hour after sunrise; the hawk flew close to the ground from bushes 30 m from the arena and knocked the grouse off its feet. After a brief struggle in which the grouse lost some breast feathers, it escaped and flew off. The hawk did not pursue but instead flew onto a post. After 2 minutes it flew off.

Although Beebe (1974) reported that Cooper's Hawks do occasionally kill large birds, such as Ring-necked Pheasants (*Phasianus colchicus*) and Mallards (*Anas platyrhynchos*), it has not been reported to attack Sharp-tailed Grouse. Neither Artmann (1970) nor Brown (1970) saw Cooper's Hawks attempting to kill these grouse. However, Berger et al. (1963) reported one possible case of an adult male Greater Prairie Chicken (*Tympanuchus cupido pinnatus*) having been killed by a Cooper's Hawk. Both these species of grouse display on open ground and have been observed to crouch, then flush upon the approach of a Cooper's Hawk (Berger et al. 1963; pers. obs.). This may be a result of the grouse's mistaking the shape and flight pattern of a Cooper's Hawk for that of a Goshawk (*Accipiter gentilis*) or because the incidence of attacks on grouse by Cooper's Hawks is sufficiently frequent that they are recognized as potential predators themselves.

I would like to acknowledge financial support from Department of Parks, Recreation and Wildlife, Province of Alberta, and from a National Research Council of Canada grant (2010) to D. A. Boag. R. Fyfe of Canadian Wildlife Service allowed me to use the CWS facilities at Wainwright. D. A. Boag made helpful suggestions on this note.

*Literature Cited*

Artmann, J. W. 1970. Spring and summer ecology of the Sharptail Grouse. Ph.D. dissertation, Univ. of Minnesota. Xerox University Microfilms, Ann Arbor, Michigan.

Beebe, F. 1974. Field studies of the Falconiformes of British Columbia. British Columbia Provincial Museum. Occasinal Paper Series No. 17.

Berger, D. D., F. Hamerstrom, and F. N. Hamerstrom, Jr. 1963. The effect of raptors on Prairie Chickens on booming grounds. *J. Wildl. Manage.* 27:778–791.

Brown, R. J. 1970. Organization and function of the spring and autumn lek of the Sharptailed Grouse (*Pedioecetes phasianellus jamesi*). M.Sc. thesis, Univ. of Manitoba, Winnipeg.

1. Present address: Brooks Wildlife Center, Box 1540, Brooks, Alberta, CANADA TOJ OJO

# SUBTERRANEAN NESTING BY PRAIRIE FALCONS

by
**Bruce A. Haak and S. Jon Denton**
**Department of Fisheries and Wildlife**
**Oregon State University**
**Corvallis, Oregon 97331**

Unusual nest site selection in Prairie Falcons (*Falco mexicanus*) has rarely been recorded. Variations from typical nest sites include one instance of tree nesting (Goss 1891) and one attempt within a hole in a lava fault (Pitcher 1977).

On 18 May 1974, we discovered a successful subterranean Prairie Falcon nest site at Rattlesnake Cave in Malheur County, Oregon. This cave, a sink-hole approximately 24 m in diameter, was formed by the collapsed roof of a lava tube. Surrounding terrain was slightly rolling with no significant relief. The nest was placed 3 m below the ground on a 12-m-high vertical wall at the mouth of the cavern.

At the time of discovery the nest contained two downy young which were observed as fledglings on 20 June 1974. To our knowledge this observation constitutes the first report of successful subterranean nesting by Prairie Falcons.

An additional subterranean Prairie Falcon nest site was reported to us (Robert Beasley, Stewart Janes, and Caryn Talbot, pers. comm.). This site, located in Lake County, Oregon consisted of a fissure approximately 804 m long, 1.5 m wide, and 4.5 m deep in an area characterized by otherwise flat terrain. The nest ledge was 1.2 m below ground level. Young fledged from this site in 1972 and 1976.

At both locations, the nesting platform consisted of stick nests probably abandoned by Common Ravens (*Corvus corax*) or Red-tailed Hawks (*Buteo jamaicensis*). The use of stick nests by Prairie Falcons and their somewhat sympatric relationship with Common Ravens was documented (Decker and Bowles 1930, Skinner 1938).

Of the hawks and falcons in western grasslands, Prairie Falcons were shown to be the least versatile in their nest-site selection (Olendorff and Stoddart 1974). However, the occupancy of abandoned quarries by Prairie Falcons (Smith and Murphy 1973) and the reports herein indicate a certain level of adaptability of this species by their willingness to occupy atypical nest sites.

We thank R. Beasley, S. Janes, and C. Talbot for supplying data, and J. A. Crawford and R. T. Reynolds for reviewing the text.

*Literature Cited*

Decker, F. R., and J. H. Bowles. 1930. The Prairie Falcon in the state of Washington. *Auk* 47:25–31.

Goss, N. S. 1891. *History of the birds of Kansas.* Geo. W. Crane & Co., Topeka, Kansas.

Olendorff, R. R., and J. W. Stoddart, Jr. 1974. The potential for management of raptor populations in western grasslands. Pages 47–88 in F. N. Hammerstrom, Jr., B. E. Harrel, and R. R. Olendorff (eds.), *Management of raptors.* Raptor Res. Report No. 2, pp. 44–88.

Pitcher, E. J. 1977. Nest site selection for Prairie Falcons. *Auk* 94(2):371.

Skinner, M. P. 1938. Prairie Falcon. Pages 18–42 in A. C. Bent (ed.), *Life histories of North American birds of prey.* Part 2. Smithsonian Inst., U.S. Natl. Mus. Bull. 170. 482 pp.

Smith, D. G., and J. R. Murphy. 1973. Breeding ecology of raptors in the eastern Great Basin of Utah. *Brigham Young Univ. Sci. Bull., Biol. Ser.* 18(3):1–76.

**Figure 1. Prairie Falcon nest site at cave entrance. Arrow shows location of stick nest platform.**

## RED-TAILED HAWK PREYS ON ADULT SAGE GROUSE IN NORTHERN UTAH

**by Cal McCluskey**
**Bureau of Land Management**
**2370 South 2300 West**
**Salt Lake City, Utah 84119**

Numerous authors have documented that the Red-tailed Hawk (*Buteo jamaicensis*) feeds predominantly, but not entirely, on mammals. Fitch et al. (1946) noted in California that the redtails diet reflected the relative abundance of prey species, such as ground squirrels, and changed to alternate species as squirrel abundance declined. Luttich et al. (1970) noted that mammals constituted 60 percent of redtail diets in their Alberta study area, and birds averaged 31 percent. Of bird remains found at active nests, 4 percent were forest grouse. Craighead and Craighead (1956) found that Sage Grouse occurred in only 1.6 percent of redtail diets in their Wyoming study area. They noted that in general, redtail's prefer to prey on small mammals but do occasionally prey on small birds. Wallestad (1976) noted that Montana redtails pose a threat to young Sage Grouse but not to adults.

I saw an adult female Red-tailed Hawk attack a female Sage Grouse near Six Mile Creek, Rich County, Utah, on 27 September 1978. The Sage Grouse was feeding in a moist meadow with approximately 35 others when I saw the approaching hawk. The group became visibly restless as the hawk approached within 100 m. When the redtail had come within 50 m, a few birds began flushing. Almost immediately, the redtail stooped and struck a single grouse. The grouse was struck approximately 2 meters above ground level, at the base of the back. The grouse and hawk remained together until they hit the ground. The hawk remained on top of the grouse until flushed by my approach. Examination of the grouse revealed that no bones were broken; however, the bird was unable to fly and appeared partially paralyzed. The wound consisted of several small punctures at the base of the back along both sides of the pelvis. The grouse was an adult female, weighing approximately 1500 g. Craighead and Craighead (1965) reported that adult female redtails averaged 1224 grams, approximately 269 grams (18 percent) less than the average female Sage Grouse. They also noted that, in general, only extremely aggressive redtails will attempt to kill an animal larger than themselves.

*Literature Cited*

Craighead, J. J., and F. C. Craighead. 1956. *Hawks, owls, and wildlife.* Stackpole, Harrison, Pa. 443 p.

Fitch, H. F., F. Swenson, and D. F. Tillotson. 1946. Behavior and food habits of the Red-tailed Hawk. *Condor* 48:205–237.

Luttich, S., D. H. Rusch, E. C. Meslow, and L. B. Keith. 1970. Ecology of Red-tailed Hawk predation in Alberta. *Ecology* 51(2):190–202.

Wallestad, R. 1975. Life history and habitat requirements of Sage Grouse in central Montana. Montana Dept. of Fish and Game. 66 p.

## ANNOUNCEMENTS

Hawk Mountain Sanctuary Association is seeking an Executive Director in order to expand its programs in conservation and raptor biology. Some management experience is preferred. For further information, send your curriculum vitae to Dr. Frank B. Gill, Academy of Natural Sciences of Philadelphia, Philadelphia, Pa. 19103.

---

The United States Fish and Wildlife Service (USFWS) has recently established a Branch of Forensic Science to provide technical and scientific support to the Service's Law Enforcement Division.

The USFWS's Division of Law Enforcement is assigned the responsibility of investigating the illegal possession, killing, processing, importing and exporting of birds, fish, reptiles, and mammals relating to interstate and foreign commerce, treaty enforcement, and national property. Much of this work deals with animals that appear on the Endangered Species List. To support this task, the Forensic Science Branch will direct its resources toward the identification of animals, animal parts (skins, blood, hair, bones, feathers, etc.), and animal products.

Inasmuch as there are in excess of 430 mammals, birds, fish, and reptiles on the Endangered Species List alone (which is, unfortunately continuing to grow), it would be clearly impossible (or at least unreasonably expensive) to staff a lab with the forensic/biological zoological experts necessary to identify parts and products from all of the animals which might be involved in a case. Instead, we hope to locate and list experts who are capable and willing to examine such evidence on a mutual aid, fee, or contractual basis. The examinations, of course, may necessitate testimony in a court of law.

In addition, we will try to develop, or continue to encourage, interest by universities and research centers in conducting research on current wildlife identification problems—particularly those involving endangered species animals, animal parts, and products.

If any members of your organization have any questions, suggestions or information regarding our program, are interested themselves, or know of someone who would be interested and qualified in working wildlife identification problems, please contact the U.S. Fish and Wildlife Service at the address listed below. A survey form will be mailed immediately to requesting individuals, data from which will be used to compile a directory of available scientific expertise in wildlife identification.

Ken Goddard, Chief
Branch of Forensic Science
Division of Law Enforcement
U.S. Fish & Wildlife Service
P.O. Box 19183
Washington, D.C. 20036
Telephone: (202) 343-9242

## HAWK TRUST NEWS

The last six months have been busy ones for the Hawk Trust. The aviaries and birds are, hopefully, soon to be moved from Hungerford to a new site in Shropshire on the border between England and Wales where there is scope for further expansion. With eight species of raptor regularly nesting near the new headquarters, some in good numbers, there will be excellent opportunities for carrying out combined field and laboratory studies.

On November 4, 1978, the Trust held a conference on the "Behavioural Ecology of Birds of Prey" at the meeting rooms of the Zoological Society of London. Papers included "A Study of Polygyny in Hen Harriers in Orkney" by Mr. N. Picozzi, "Patterns of Predation by Peregrines Breeding in Northern Scotland" by Mr. D. Weir, "Territory Usage by Tawny Owls" by Dr. A. R. Hardy, "The Role of Vultures as Scavengers" by Dr. D. Houston, and "The Hunting Strategies of Raptors" by Dr. N. Fox. There were also several short communications on more general aspects. It was an interesting and enjoyable day and drew raptor enthusiasts from far and wide together under one roof to discuss recent advances. Details of the proceedings of the conference, which will be published in 1979, can be obtained from the Hawk Trust, P.O. Box I, Hungerford, Berkshire RGI7 OQE.

Research during the last year has concentrated mainly on the bioenergetics of the Kestrel and on the growth and development of this and other species, but other studies have been undertaken including a bacteriological and haematological survey. This year the Trust successfully bred Kestrels (*Falco tinnunculus*), Buzzards (*Buteo buteo*), Snowy Owls (*Nyctea scandiaca*), and Tawny Owls (*Strix aluco*) in connection with research projects.

**James S. Kirkwood**

## ABSTRACTS OF THESES AND DISSERTATIONS

## NOCTURNAL, PREROOSTING AND POSTROOSTING BEHAVIOR OF BREEDING ADULT AND YOUNG OF THE YEAR BALD EAGLES (*HALIAEETUS LEUCOCEPHALUS ALASCANUS*) ON THE CHIPPEWA NATIONAL FOREST, MINNESOTA.

Nocturnal roosting behavior of nesting Bald Eagles and associated young of the year was studied during the 1974–1976 nesting seasons within the 6,475 km$^2$ Chippewa National Forest in Minnesota. Direct observations of 14 patagial color tagged young, 2 radio tagged young, and adults from 8 nesting efforts were made at and away from nest trees during nocturnal, twilight, and diurnal time periods. Roosting behavior of eagles closely coincided with nocturnal time periods defined by the nautical twilight standard (sun 12° below horizon). Eagles were inactive (as recorded via Noctron IV night vision scope) during these roosting periods. Multiple regression analysis determined that length

of twilight, cloud cover, and presence of a full moon were significant factors ($P<0.01$) influencing the timing of eagle roosting relative to sunrise and sunset. These factors, all affecting relative light intensity, accounted for 72% and 68% of the variability in the timing of first morning activity and last evening activity, respectively. Higher ambient light conditions relative to sunrise or sunset (as indicated by long twilight period, lack of cloud cover, or presence of a full moon) resulted in later initiation of roosting in the evening and earlier termination of roosting at dawn. Temperature, nest site, and age of the eagle (adult or young) did not significantly ($P<0.05$) affect the timing of roosting behavior. Observations indicated that a single adult roosted at the nest tree until nestlings were approximately 7 weeks old, at which time adult nest-tree roosting behavior terminated at all nests. From incubation to the fledging of young, adult roost locations away from the nest tree were primarily at repeatedly used supercanopy trees within 400 m of the nest. Fledgling eagles, including siblings, differed considerably regarding use of the nest tree for roosting. Nest trees continued to be important roosting locations for some fledglings through the first few weeks after their first flight. With progress of the nesting cycle, adults and fledglings roosted at increasingly greater distances from the nest tree. However, 4 weeks after their first flight, some fledging roost locations still ranged to within 12 m of the nest tree. Adults roosted to 1,866 m and fledglings as far as 3,057 m from the nest tree prior to dispersal of the young from the forest. After fledgling, siblings showed a slight tendency to roost together (29 of 115 observations), this behavior occurring primarily in recently fledged young. Adults rarely were observed roosting with fledged young (2 of 102 observations). Characteristics of 44 identified roost trees were variable regarding species, height, distance to water, and community type. However, most roosts occurred on habitat edges (55%) and had considerable foliage (89%). Based on observed relative use of identified roosts in this study, identification and protection of actual and potential important roosts within other eagle nesting territories appear practical within only a 400-m zone around nest trees.

Pramstaller, Michael E. 1977. Nocturnal, preroosting and postroosting behavior of breeding adult and young of the year Bald Eagles (*Haliaeetus leucocephalus alascanus*) on the Chippewa National Forest, Minnesota. M.S. thesis, University of Minnesota, St. Paul. 97 pp.

Present address: Michael E. Pramstaller
Raptor Information Center
National Wildlife Federation
1412 16th Street, N.W.
Washington, D.C. 20036

## BOOK REVIEWS

A symposium on African predatory birds. 1977. South African Ornithological Society. 108 p. Paper covers. Price (unstated). Obtainable through Northern Transvaal Ornithological Society, P.O. Box 4158, Pretoria 0001, South Africa.

This collection of papers was presented at the 1977 Symposium on African Pre-

datory Birds. The contents consist of 11 papers printed in full text and 16 papers represented by title and abstract. The opening addresses set the tone for the symposium, with Ian Newton discussing population regulation in diurnal birds of prey (abstract only) and Leslie Brown providing a comprehensive summary of the current knowledge about all species of African birds of prey.

The topics of other papers for which the full text is provided are classified into three categories: predatory behavior, predator biology, and predator conservation. Predatory behavior is represented by one interesting paper which compares the prey and foraging methods of the terrestrial hunting Ground Hornbill and the Secretary Bird. Articles about predator biology include an ecological comparison of four sympatric owl species in Transvaal, South Africa, and papers on aspects of the general ecology of the Long-crested Eagle, Mackinder's Eagle Owl, Dickinson's Kestrel, and Greater Kestrel. Also there is a comprehensive paper on the various raptor measurements used to document aspects of bird design. Articles about predator conservation include a comparison of Black Eagle populations in protected and unprotected areas, a status report on the raptors of the Eastern Cape, South Africa, and a description of raptor leg surgery. Papers read at the symposium that are represented only by abstracts cover a wide variety of topics including, for example, the food resources of two sympatric *Phoebetria* albatrosses, Bat Hawk feeding behavior, Snake Eagle biology, Peregrine Falcons in Victoria, Australia, and several reports on Cape Vulture research.

The primary value of this publication is that it provides the reader with a spectrum of the types of avian predator research which are currently being pursued in Africa by many of the continent's leading raptor biologists. For persons seriously interested in African raptor research, this publication offers an opportunity to obtain a series of generally good papers on research currently in progress.

Thomas L. Thurow

**Bird of Prey Management Techniques. 1978. T. A. Geer (ed). A symposium sponsored by the International Association of Falconry and Conservation of Birds of Prey. 160 pp. Price not stated. (Available through T. A. Geer, Minor Road, Brewster, New York 10509.)**

Because research on birds of prey has undergone a rapid growth in the past decade, the number of symposia treating them has likewise increased. These symposia tend to treat specific topics, and this symposium has brought together a truly international group of individuals concerned with the problems of management. The meetings were held at Wadham College, Oxford, England. In all, 202 participants are listed representing some 20 countries, although Europeans were in the majority. There are five major areas of discussion, and each area had several contributing papers. These areas are (1) Population Dynamics and Habitat Management, (2) Reducing Mortality in the Wild, (3) Increasing Productivity in Wild Populations, (4) Captive Breeding and Release as Management Techniques and (5) General Considerations (a discussion of falconry, legal and economic problems). Of the 17 papers published in this volume, most appeared to offer new material although two were taken from *Endangered Species* (S. A. Temple (ed.) 1978.).

Some of the papers, while of general interest, report on projects of regional scope such as the *Project Eagle-Owl, South West,* which describes the introduction of Eagle Owls in a small area of southwestern Sweden. Others, *Productivity Manipulation in Wild Eagles,* as an example, are review papers of a general nature. The opening address by T. Lutz, president of IAFCBP, sets the tone of the conference and reminds us that birds of prey have a variety of meanings to us all. We frequently need this reminder, and thus I quote from his address: "One has an admiring, revering love for them, the other loves them as a scientific object, another loves them as a possession, and yet others find the fulfillment of their love in the partner relationship with them." All are valid viewpoints. All in all the proceedings of this conference are recommended highly.

C. M. White

**Hawks and Owls of North America. D. S. Heintzelman. 1979. Universe Books, New York. 197 pages. 8 color plates, many black and whites. $18.50.**

Donald Heintzelman is a well-known author to most people interested in raptors and has produced another fine book to add to his list of quality works. In the preface, the author states that *Hawks and Owls of North America* is not written on a professional level, but rather, is a guide for the general public. To those familiar with Heintzelman's other books, this style is probably his hallmark.

The subtitle of this book is "A Complete Guide to North American Birds of Prey," and indeed, the list of included raptors is exhaustive. For example, the roadside hawk (*Buteo magnirostris*) is discussed, even though Heintzelman documents it as being seen only once in North America. The description given for each species varies greatly, but generally includes information on nesting, feeding, identifying features, and unique characteristics. I can forsee some criticism about the amount of space given to some birds while others seem neglected, as with the eight pages describing the osprey compared to the fewer than four pages devoted to the red-tailed hawk.

Chapters are divided taxonomically, plus Heintzelman includes several short sections on topics such as ecology, migration, and conservation. An appendix, listing raptor related organizations, is included as well as a seven-page list of selected references. Overall, the book is well written and interesting, and would be a nice addition to the bookshelf of anyone interested in hawks and owls.

William K. Parker

## THE RAPTOR RESEARCH FOUNDATION, INC.
## OFFICERS

**President** Dr. Richard R. Olendorff, Division of Resources (C-932), B.L.M., 2800 Cottage Way, Sacramento, California 95825

**Vice-President** Dr. Joseph R. Murphy, Department of Zoology, 167 WIDB, Brigham Young University, Provo, Utah 84602

**Secretary** Dr. Donald R. Johnson, Department of Biological Sciences, University of Idaho, Moscow, Idaho 83843

**Treasurer** Dr. Gary E. Duke, Department of Veterinary Biology, College of Veterinary Medicine, University of Minnesota, St. Paul, Minnesota 55101.

Address all matters dealing with membership status, dues, publication sales, or other financial transactions to the Treasurer.

Send changes of address to the Treasurer.

Address all general inquiries to the Secretary.

See inside front cover for suggestions to contributors of manuscripts for *Raptor Research, Raptor Research Reports,* and special Raptor Research Foundation publications.

## BOARD OF DIRECTORS

**Eastern** Dr. Mark R. Fuller, Migratory Bird Lab., U.S.F.W.S., Patuxent Research Center, Laurel, Maryland 20811

**Central** Dr. James Grier, Department of Zoology, North Dakota State University, Fargo, North Dakota 58102

**Pacific and Mountain** Dr. Joseph R. Murphy, Department of Zoology, 167 WIDB, Brigham Young University, Provo, Utah 84602

**Canadian Eastern:** Dr. David Bird, Macdonald Raptor Research Center, Macdonald College, Quebec, H9X 1CO, Canada
**Western:** Dr. Wayne Nelson, 620 Harris Place Northwest, Calgary, Alberta, T3B ZV4, Canada

**At Large** Dr. Stanley Temple, Department of Wildlife Ecology, Russell Laboratory, University of Wisconsin, Madison, Wisconsin 53706

**At Large** Dr. Thomas Dunstan, Biology Dept., Western Illinois University, Macomb, Illinois 61455